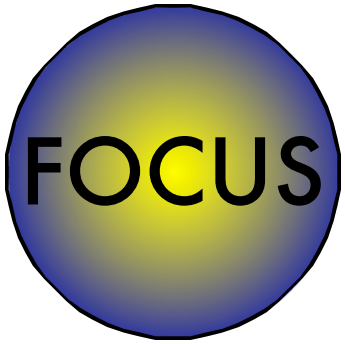
Sub-Picosecond Pulse Source



Single-shot Temporal Characterization of the SPPS Electron Beam

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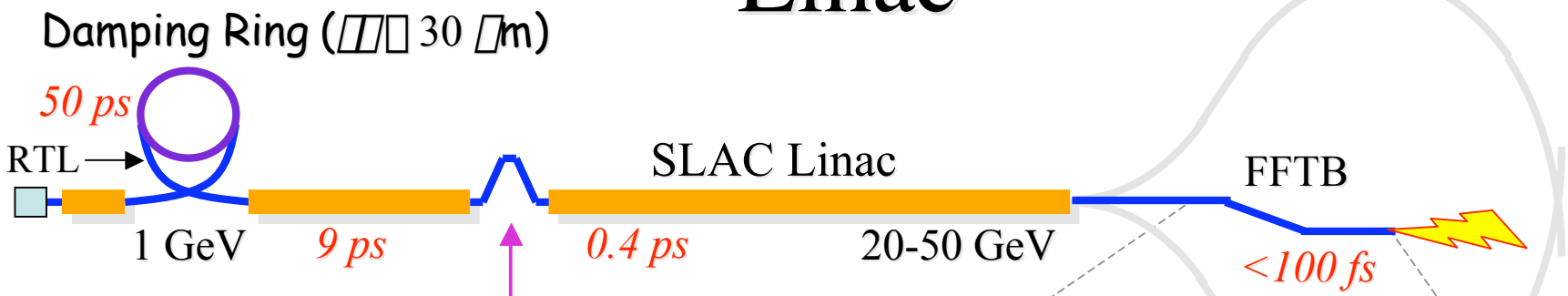
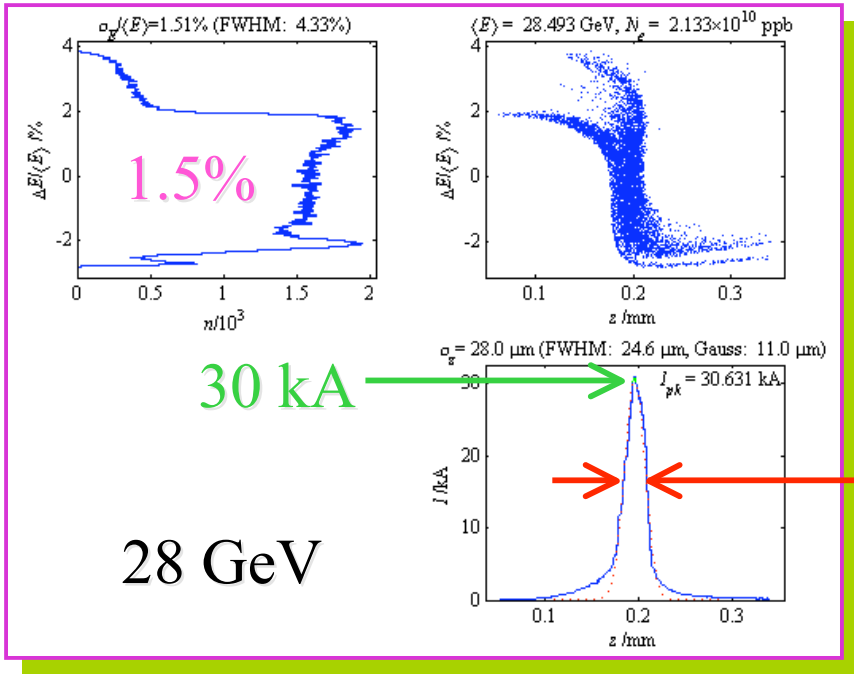
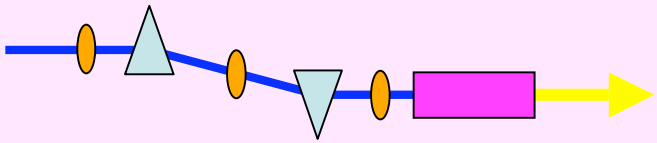
Short Bunch Generation in the SLAC Linac



Add 12-meter chicane compressor in linac at 1/3-point (9 GeV)

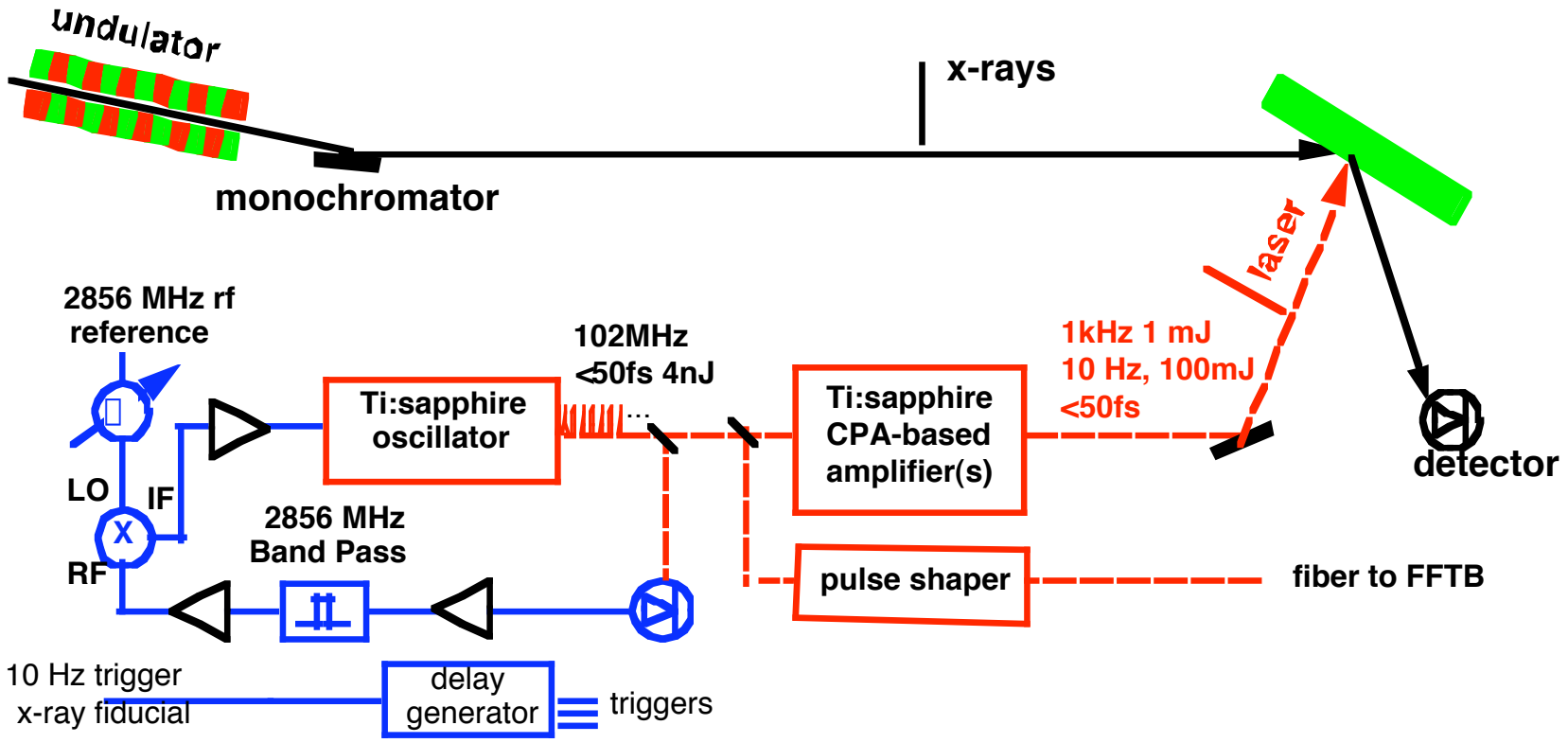


Existing bends compress to **<100 fsec**



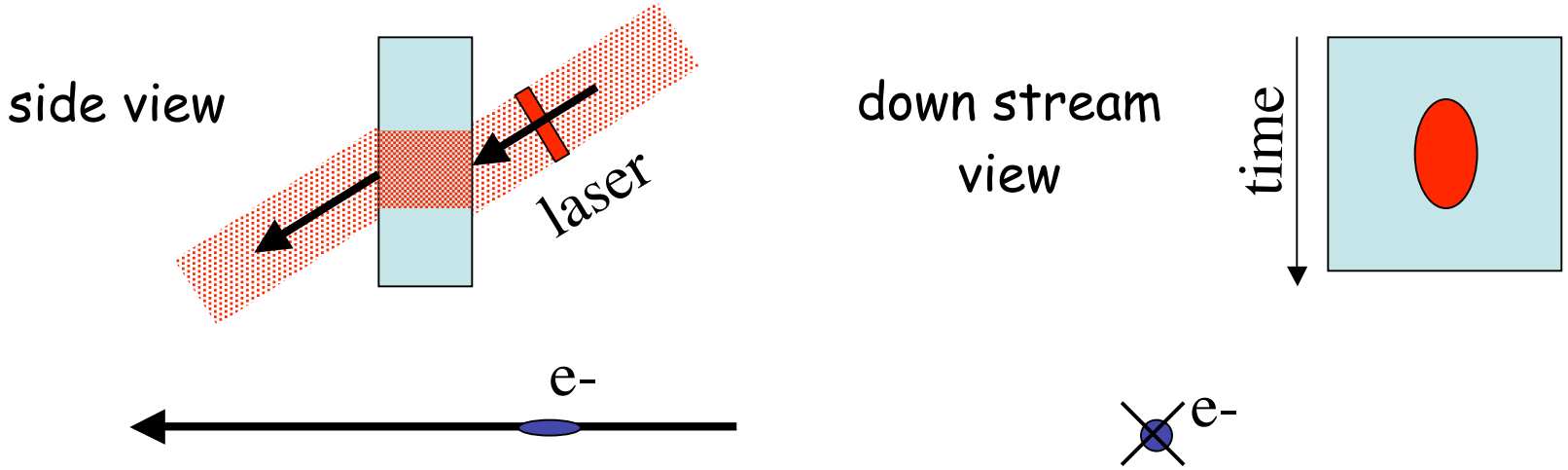
Jerry Hastings

Laser-pump-X-ray-probe

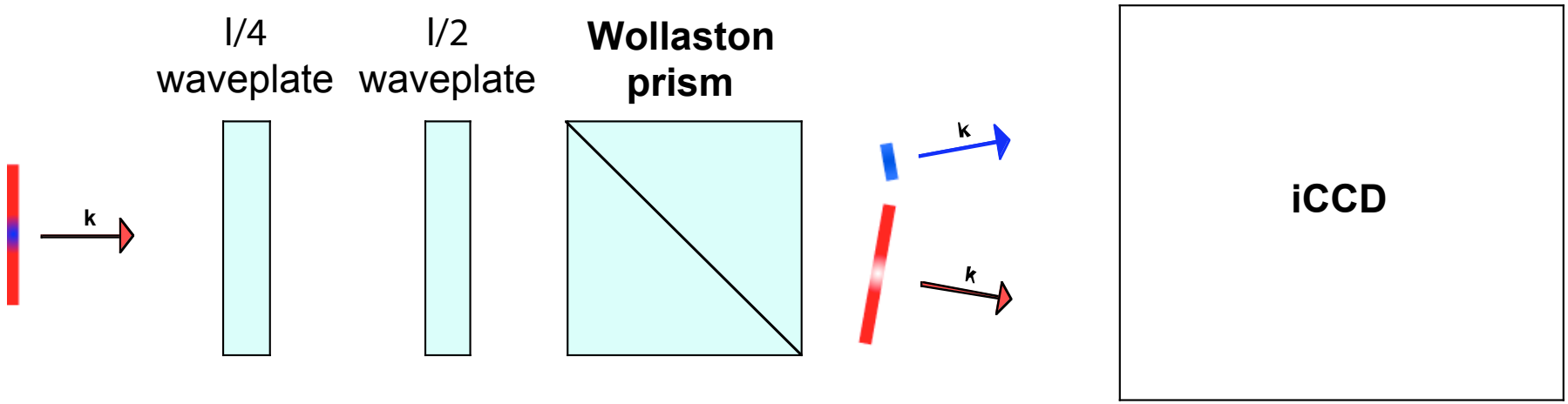


- Resolution limited by timing jitter in conventional pump-probe.
- Must measure everything on every shot.

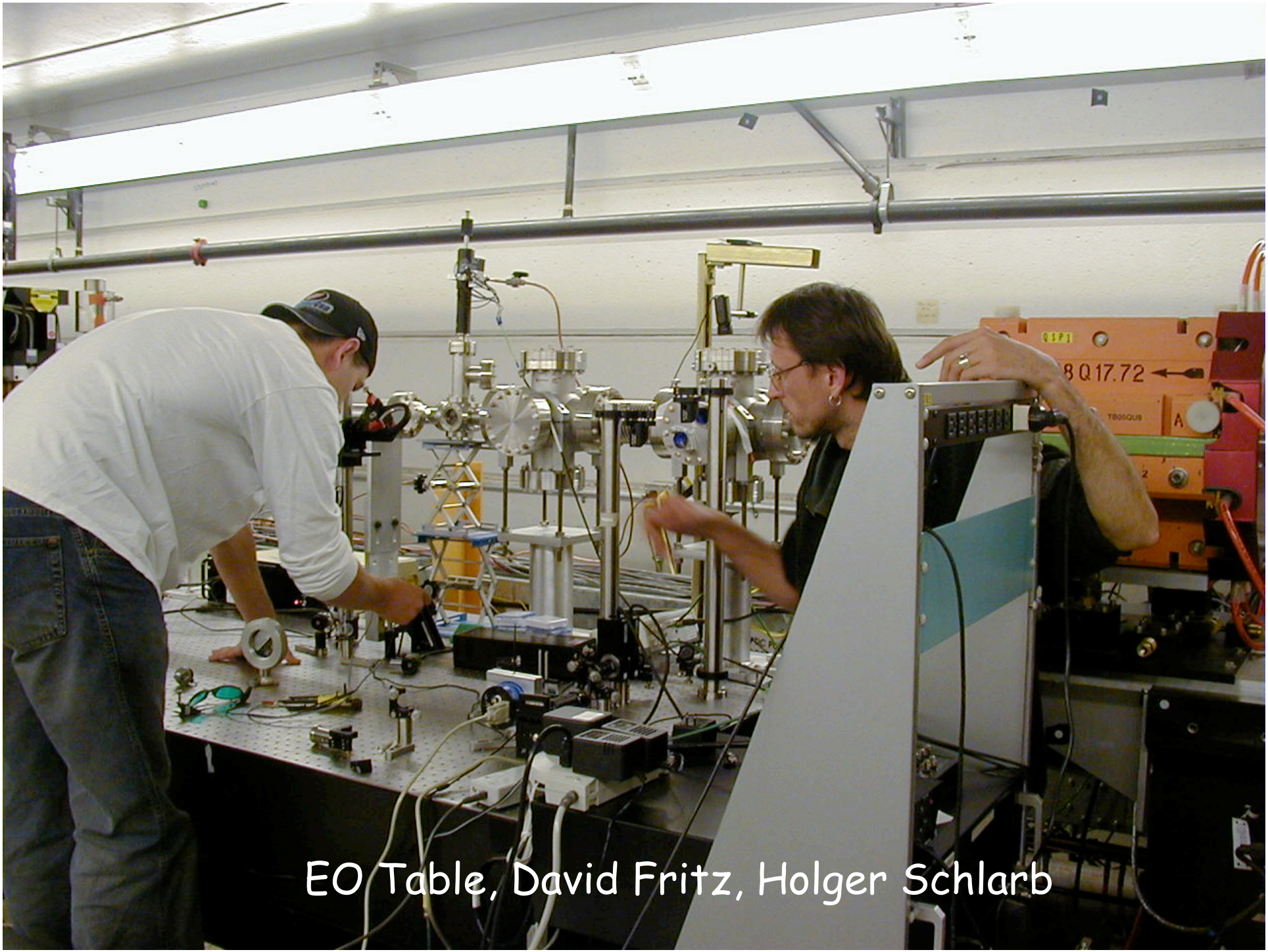
Timing by Single shot Electrooptic sampling



Detection




Undulator,
View upstream
Dave Fritz, Soo Lee, David Reis

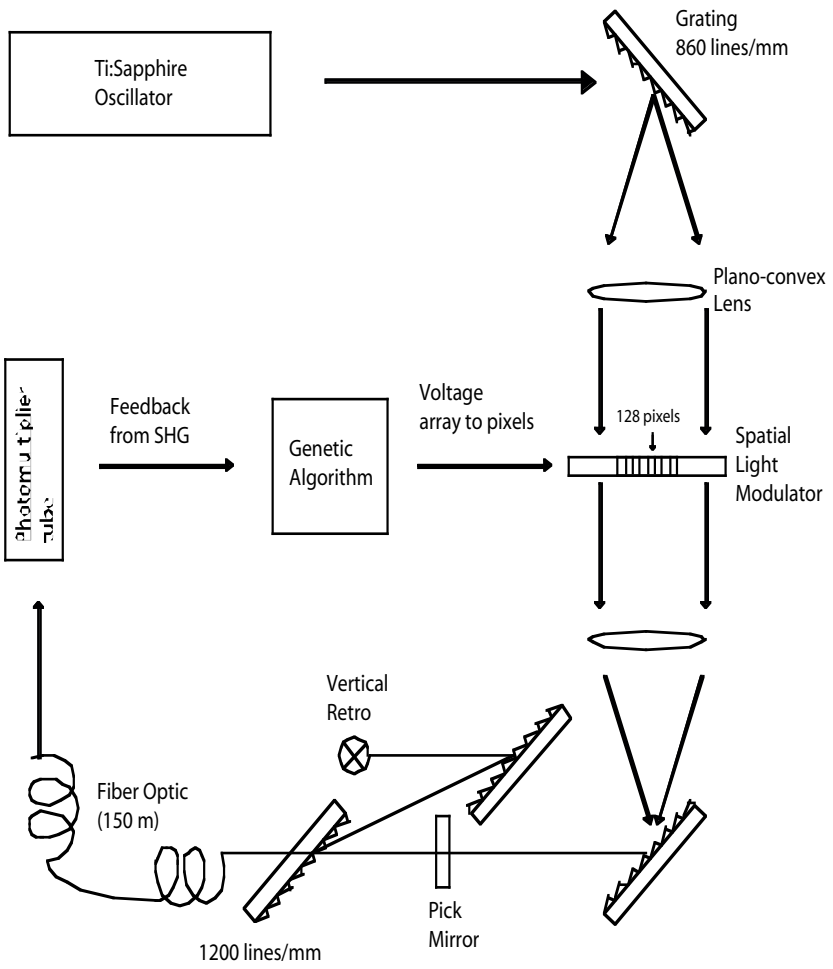


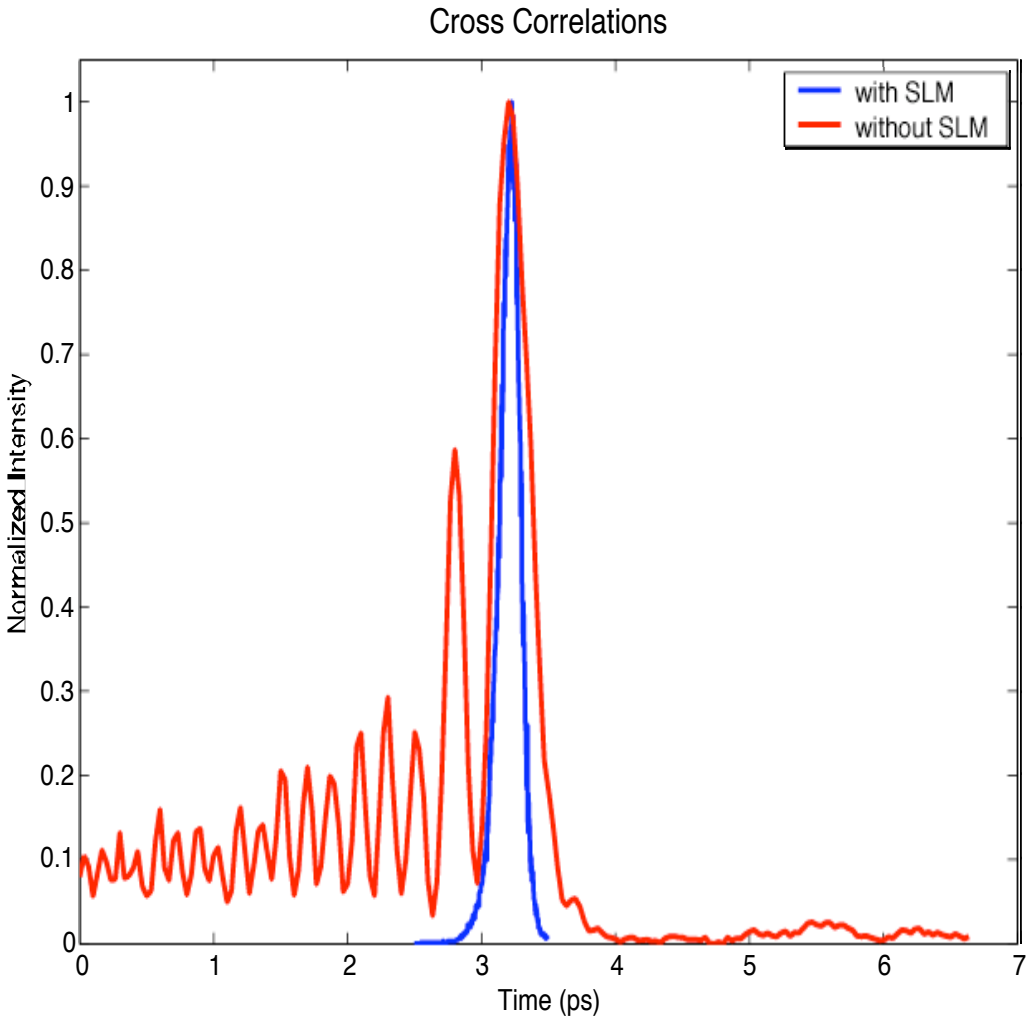
EO Table, David Fritz, Holger Schlarb

Laser transport

Problem: Laser is 150m from the undulator.
early oscillator pulse transported by optical fiber

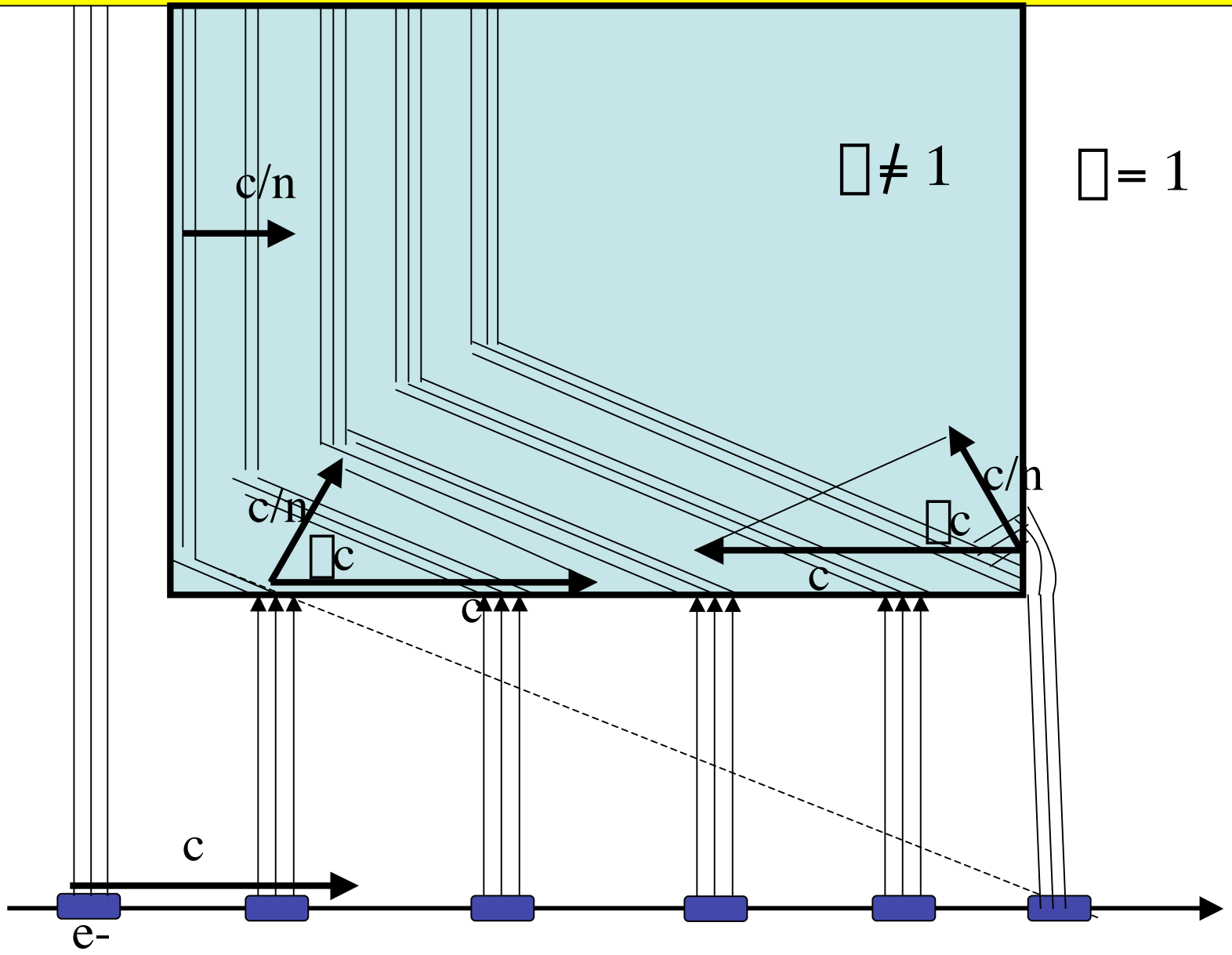
dispersion pre-compensation using adaptive pulse shaping and learning algorithm



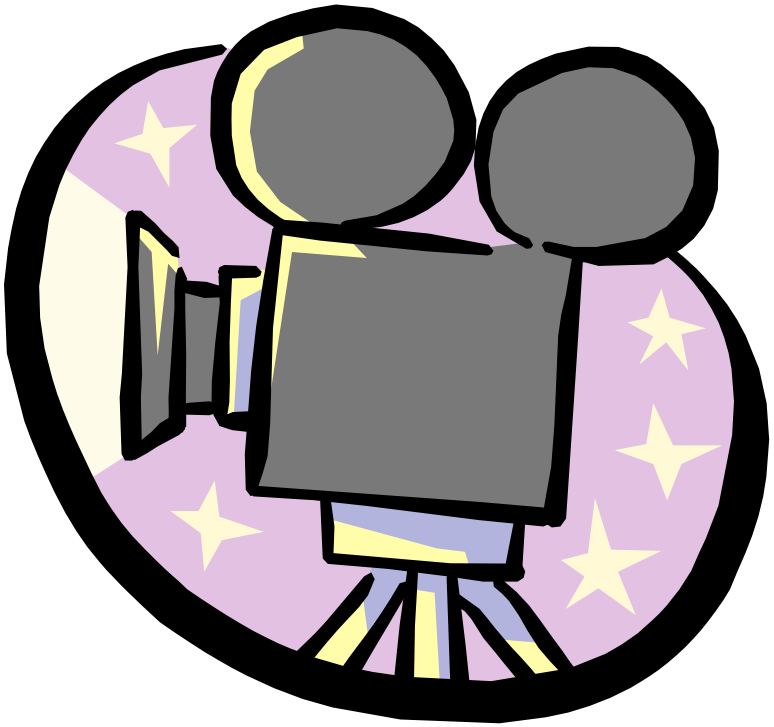


now that we have a short probe pulse....what will we probe?

Electric field of an ultra-relativistic electron bunch

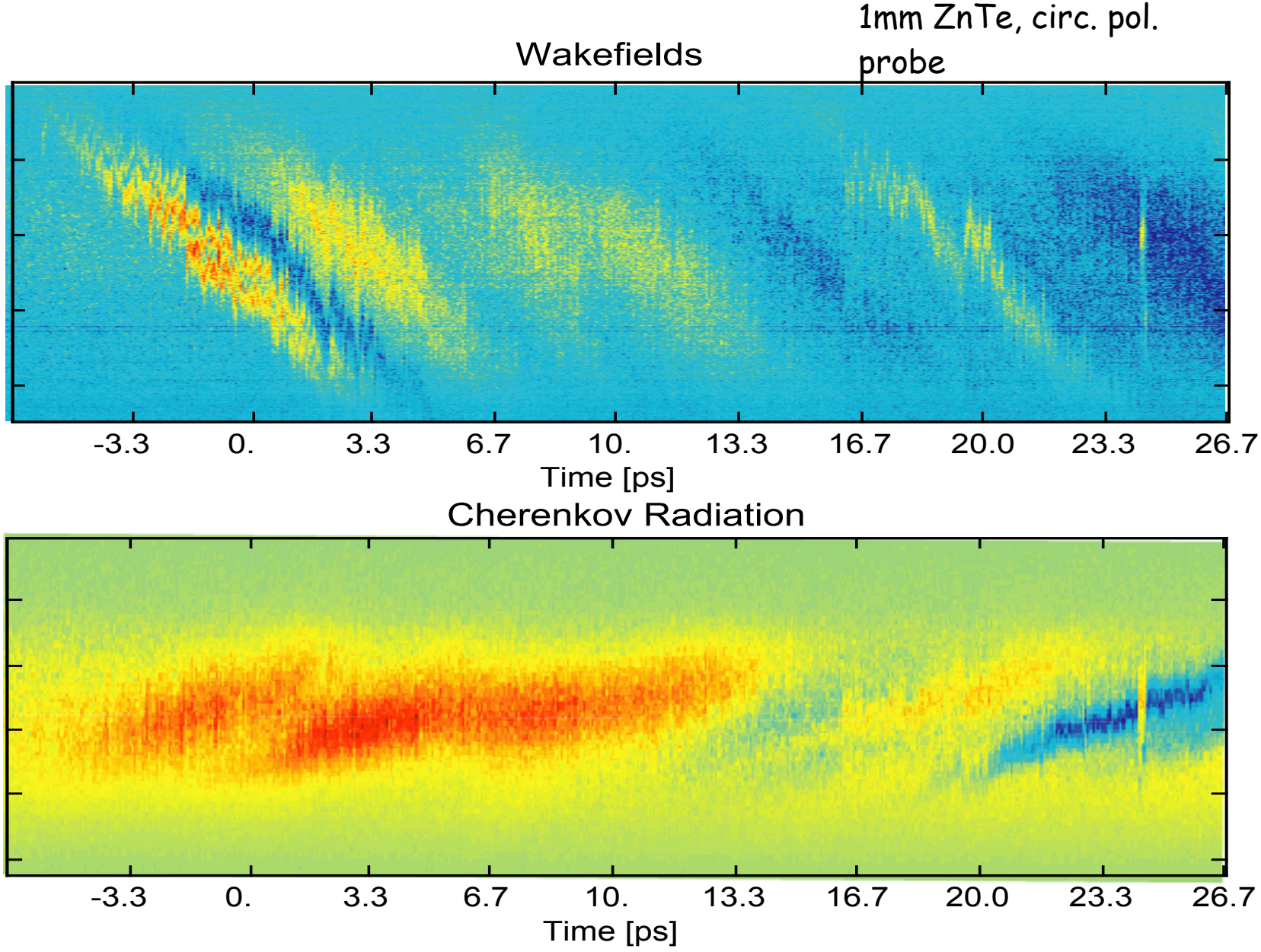


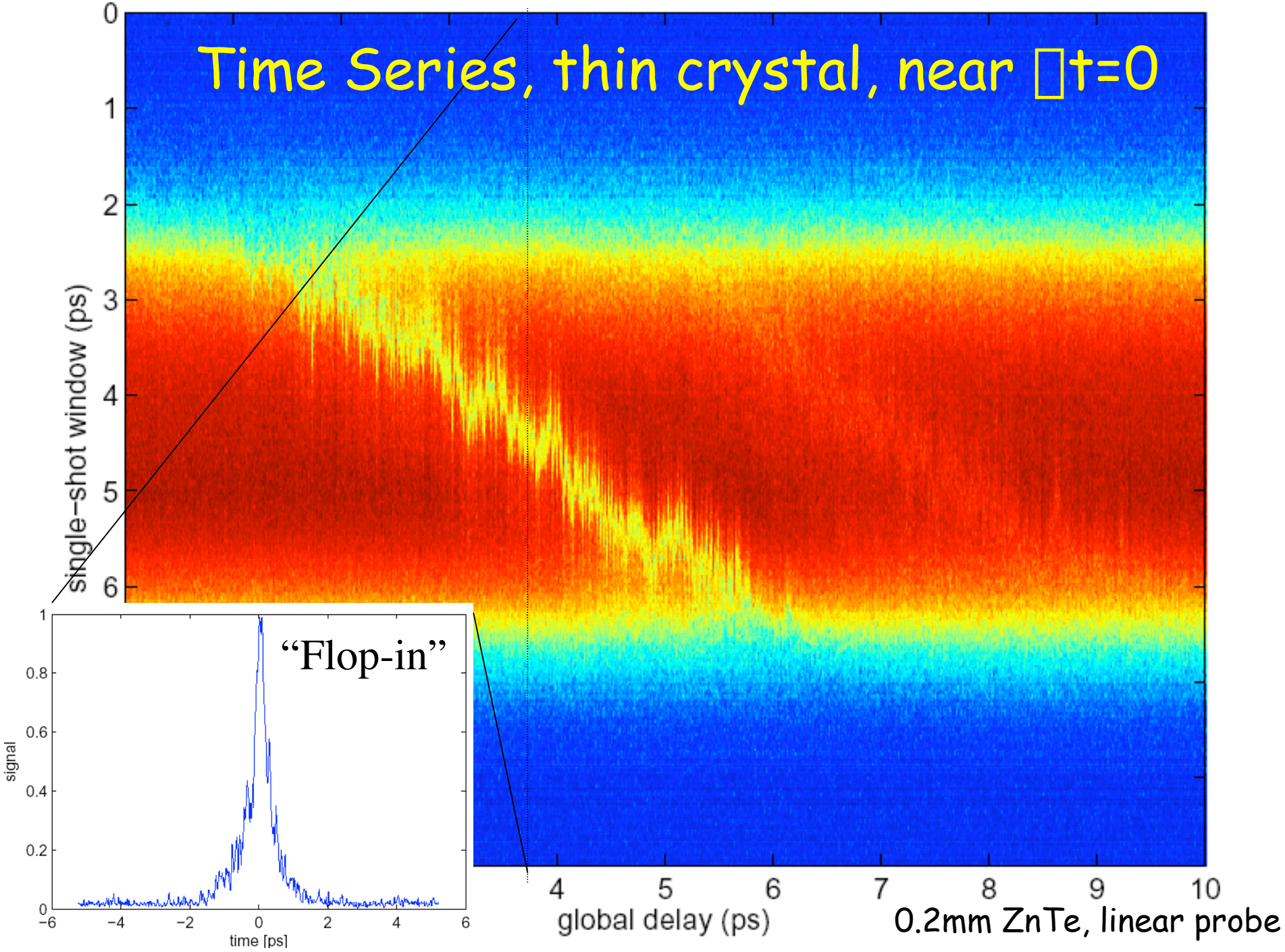
Cool movie went here....



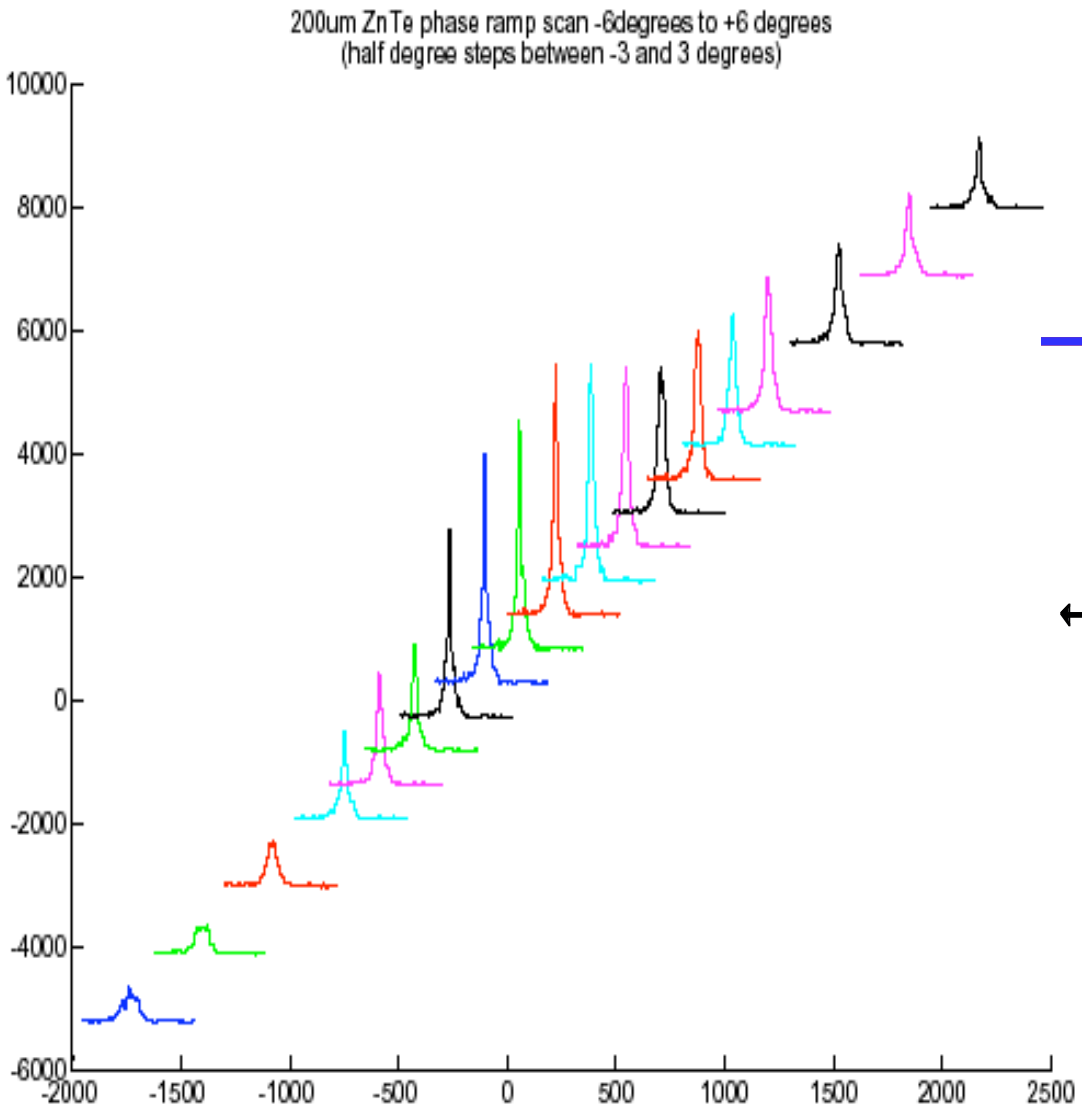
Time Series of Single Shot EO Measurements

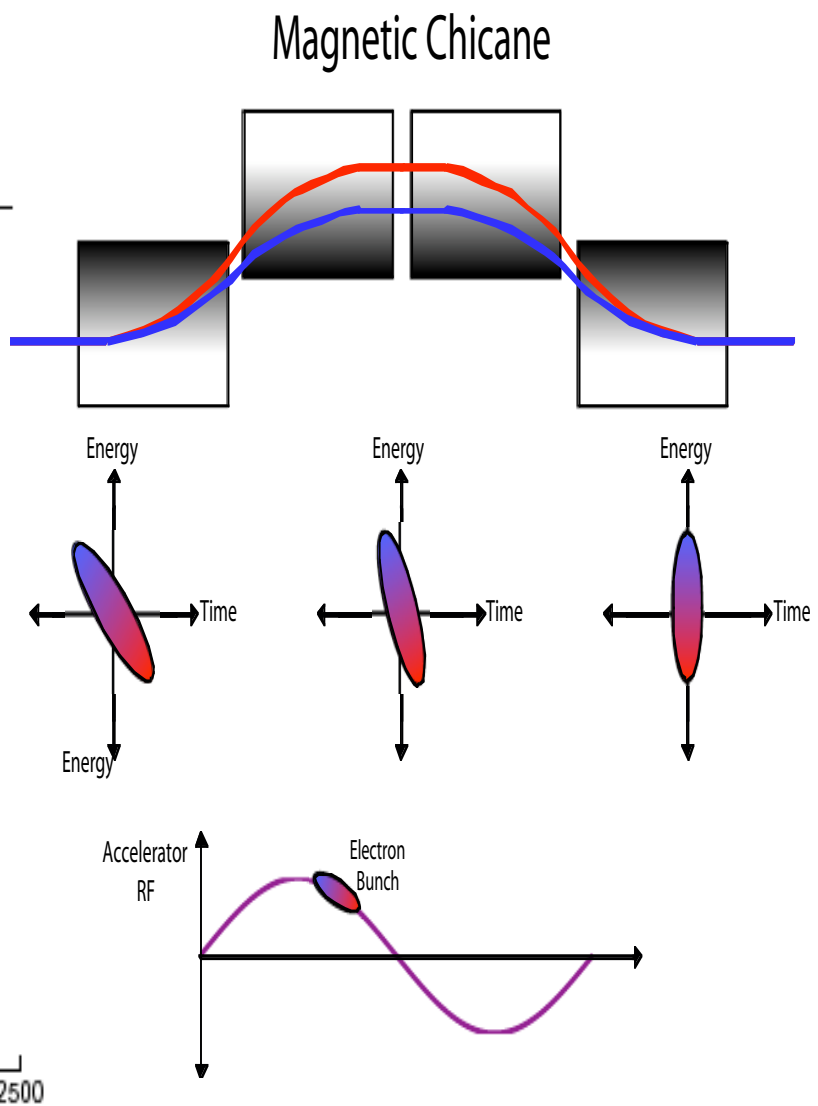
(balnaced detection) shows two directions of THz propagation




Time Series, thin crystal, near t=0
single−shot window (ps)
0
1
2
3
4
5
6
4
5
6
7
8
9
10
global delay (ps)
0.2mm ZnTe, linear probe
“Flop-in”
signal
time [ps]
1
0.8
0.6
0.4
0.2
0
−6
−4
−2
0
2
4
6

Pulse broadening off optimum phase in compressor





Current Status

- Measured down to ~280 fs (FWHM) using prompt signal on a SINGLE SHOT
- relative time can be determined to <100fs on EVERY SINGLE SHOT

- Observation of Coherent Cherenkov Radiation (Proximity)
- Short term jitter < 1 ps (~250fs rms)
- long term timing can be achieved by fiber length compensation

- need to correlate w/amplified laser & x-rays in hutch
- new crystal geometry and thinner crystal to maximize resolution...further work on simulations to understand fields better...

Calculated Undulator Output

E_e = 28 GeV
3.2 nC
λ_u = 8.5 cm
K ~ 4
E_{ph} = 9.1 keV
Intensity in mono acceptance
2 x 10^7 photons/per pulse

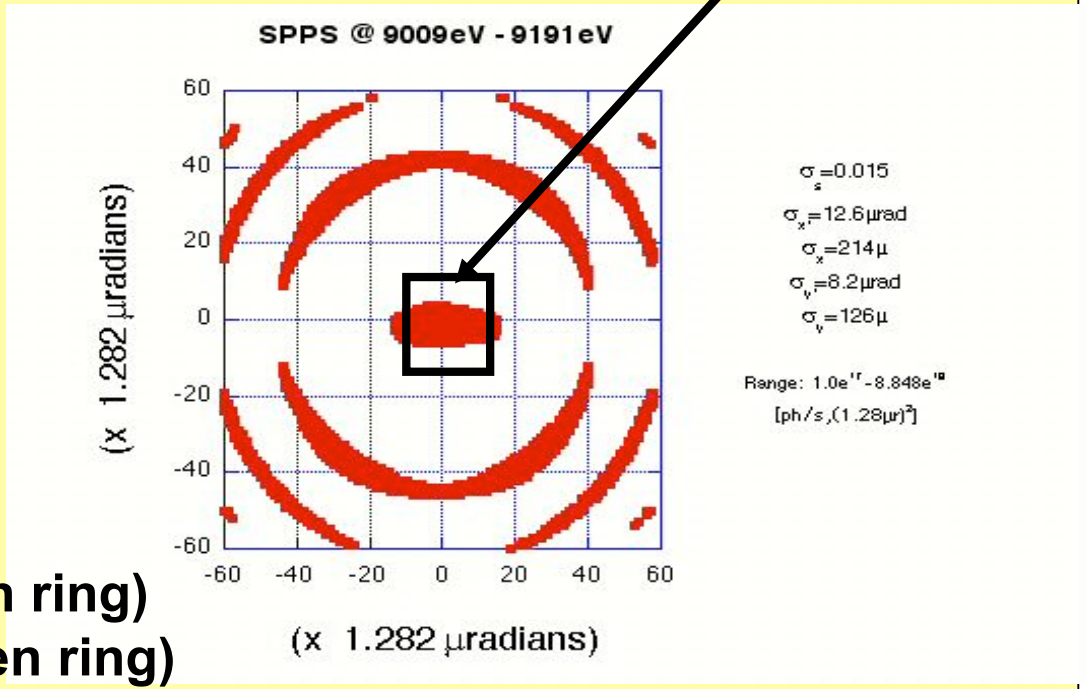
Measured Output

2 x 10^7 photons/per pulse

Emittance

0.4 nm-rad horiz (~3 - 3rd gen ring)
0.06 nm-rad ver (~.03 - 3rd gen ring)

Monochromator acceptance



Typical 10 Hz operation